



Saguaro National Park: Protecting Natural Resources in a Rapidly Developing Landscape

The sky is a brilliant display of bright red, yellow, orange and pink. The dry, rocky mountain-scape ruggedly cuts across the skyline. And a lone, majestic cactus casts a long shadow as the desert sun slips below the horizon. This depiction of the iconic American Southwest is embodied in one of America's crown jewels, Saguaro National Park. Saguaro offers visitors striking beauty and a chance to experience a special kind of wilderness. The Park is located in a unique area where thick forests are replaced by stoic cacti: mountain islands surrounded by desert seas.



Saguaro cacti at sunset. Large saguaros like these take hundreds of years to reach this size. NPS photo archive.

Saguaro is also unique among America's national parks for a different reason: it is split into two separate districts by a rapidly growing urban area, Tucson and surrounding communities (Figure 1). Since the creation of Saguaro as a National Monument in 1933 (it became a National Park in 1994), Tucson has been one of the fastest growing cities in America.

The area has grown roughly 2,500% from a small city of about 50,000 to a bustling metropolis of one million with interstate highways, urban sprawl, and an international airport.

The early pioneers of Saguaro could never have predicted this urban explosion, and their original management plans did not address the issue. Though the areas around the Park have changed drastically since their time, the visions of these pioneers still live on today.

The current park general management plan has the same goal as the original:

- Preserve the wilderness qualities of solitude, scenic vistas, and natural conditions
- Promote understanding and stewardship of the Park's natural resources through appropriate scientific study
- Provide opportunities for understanding and enjoying the Park in a manner that is compatible with the preservation of resources and wilderness character

Moving into the 21st century, urban growth around Tucson shows no signs of slowing. Now more than ever it is imperative that Saguaro evaluate human impact in order to develop a sustainable management plan that deals with urban encroachment on the Park.

Measuring Human Impact on a Landscape

Actually measuring the level of human impact on a park landscape is difficult in part because no universal measurement exists, and different types of human factors effect resources in different ways. Consequently, the National Park Service (NPS) uses several measurements to assess human impact, including population, housing, roads, and impervious surface. Here, we illustrate the general patterns of human impacts according to housing development and roads.

Housing density is measured as the number of houses per unit area. Maps in Figure 2 illustrate how housing densities in the Tucson area have changed between 1950 and 2010, and further how they are expected to change in another 80 years by the year 2090.

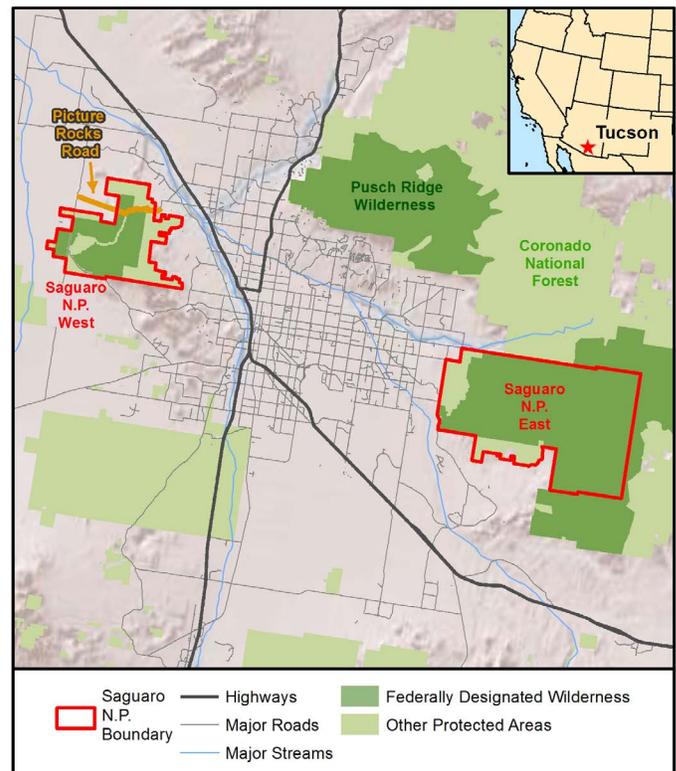


Figure 1. The Tucson Mountain District (West) and Rincon Mountain District (East) of Saguaro National Park, separated by Tucson and surrounding communities.

Measuring Human Impact on a Landscape

In the past 60 years the city has exploded. What were once distant city lights twinkling on the horizon are now porch and street lights of urban sprawl that extend to park boundaries. Similarly, looking forward to 2090, it is predicted that Saguaro – especially the western Tucson Mountain District – will increasingly become an island of wilderness nearly surrounded by suburban development occurring on private non-conservation lands.

Higher housing densities adjoining Saguaro mean more interactions between humans and park resources. These interactions come in many forms. Several interactions of interest to park management include human trespassing, increased pollution, encroachment of invasive species, and encounters between pets and wildlife.



Urban sprawl from a Tucson hillside. Photo from <http://cactuslovers.com>.

Roads are also impactful to Saguaro. They dissect the landscape, create barriers to wildlife movement, distribute pollution beyond developed areas, and help invasive species spread. Pristine, undisturbed Wilderness areas, like those that account for the majority (78%) of the Park, are highly vulnerable to impacts from roads.

Road density maps clearly show the close proximity of urban roads to park boundaries (Figure 3). Even more concerning are busy commuter roads that penetrate the west district of the Park. These roads fragment otherwise pristine tracts of wilderness, giving urban influences a channel into the heart of the Park.

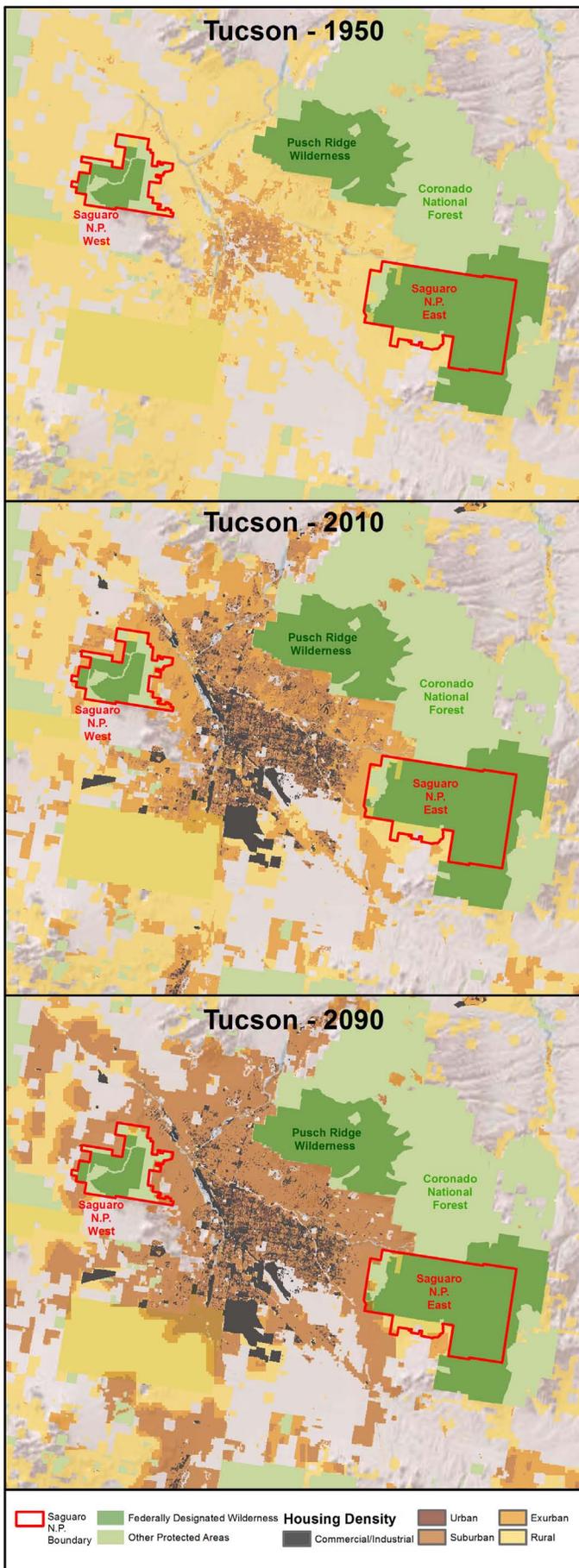


Figure 2. Changes in housing densities in the Tucson area: 1950 (top), 2010 (middle), and projected to 2090 (bottom). Although the footprint of development does not change substantially over this period, the density of homes increases dramatically, reaching suburban status in developable areas around both the Tucson and Rincon Mountain Districts.

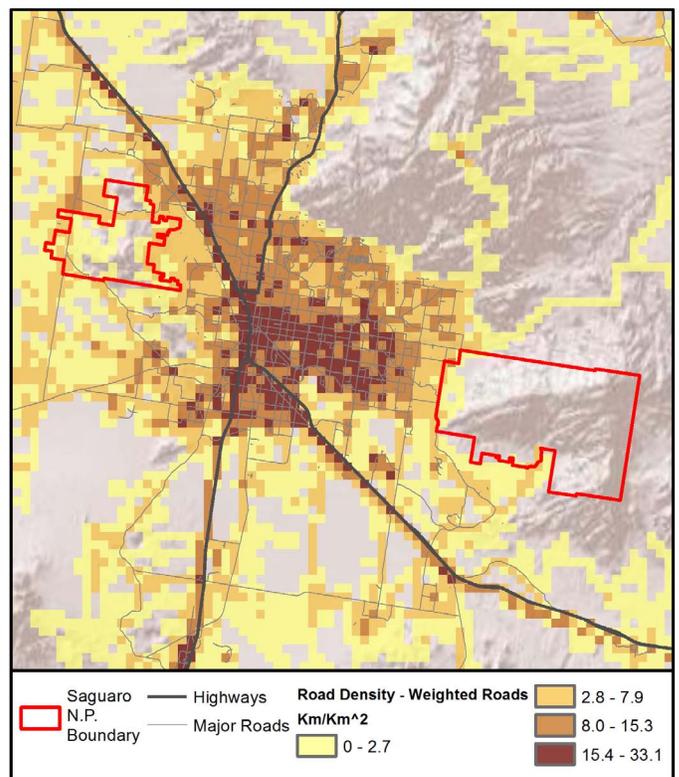


Figure 3. Road density in the Tucson area.

The Effects of Development on Park Resources

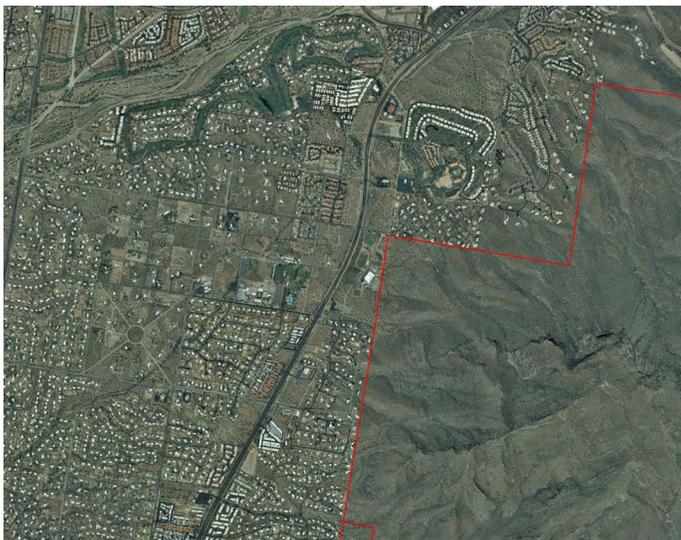
Regardless of how it is measured, the total level of human impact on the landscape around Saguaro is very high, and on the rise. This growth has many effects on the Park's natural resources:

- Isolation of the Park from other natural and protected areas
- Degradation of the natural character within the Park
- Introduction and spread of invasive species
- Increased atmospheric and noise pollution

Keeping our Wild-lands Wild: Isolation and Destruction of the Natural Landscape

When a park is disconnected from other natural areas that surround it, the park becomes an island. This can be very harmful to park natural resources, and avoiding this situation is a priority in NPS management plans today. Back in 1916 when the NPS was established, it was believed that simply establishing protected areas would afford lasting protection of the natural and cultural resources of interest.

More recently, it has become apparent that this is not the case. Through careful scientific study of park ecosystems, it is now known that changes in land use outside of park boundaries have profound and lasting effects on almost all parks.



Protected islands are created when development occurs up to the boundaries of protected areas. This example is for the US Forest Service, Pusch Ridge Wilderness (western edge, right side of red line), near Oro Valley (left side of red line).

Unfortunately no park can protect an entire ecosystem and all of its functioning components – the scale of this is simply too monumental for any single protected area like Saguaro National Park. Instead, the NPS and other landowners (State, Federal, NGO, local governments) must use their limited resources to strategically protect what they can, and work together to create ecosystem management plans that function in synergy across management boundaries.

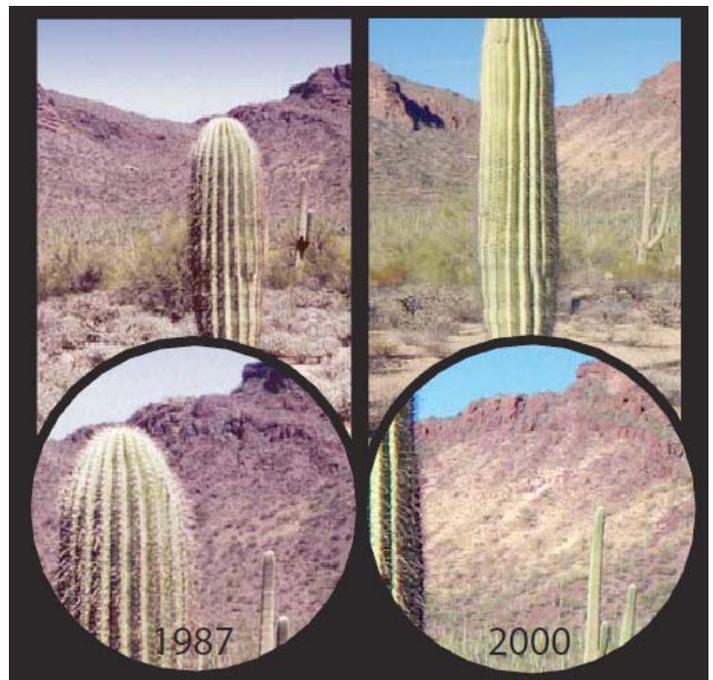
Another important resource is the natural character of the Park as a whole. A general goal of the NPS is to sustain the natural appearance and workings of the lands under its jurisdiction.

Because of their protected status, most parks appear natural, but a different and equally important question for future generations is whether the full suite of natural processes are in place to enable ecosystem function. Even if an area remains outwardly natural in appearance, human stressors can and will cross park boundaries to interfere with park workings: wildlife may be driven away because of noise from traffic or homes, domestic animals may spread disease to wildlife or cause them to behave differently than they naturally would, and invasive grasses can establish and spread in areas that have been disturbed. Any of these factors may critically disrupt park natural processes.

The introduction of invasive species can have drastic effects on both natural resources and visitor experience in a park. Invasive species are those that are not a natural part of the ecosystem, but have instead either colonized or been brought in from somewhere else, usually by humans. The general conservation issue with invasive species is that they interfere in some way with the native ecosystem, and this interference happens so fast that the native ecosystem does not have time to adapt or respond. In particular, invasive species can disrupt important biotic interactions among native species, with major cascading effects. For example, saguaros are both pollinated and dispersed by bats, and saguaro trunks are commonly used by cavity nesting birds like the Gila woodpecker. Hence, any disruption or displacement of saguaros would have corresponding effects on the other native species that depend on the saguaro, which may in turn propagate additional cascading change throughout the ecosystem. Enter buffelgrass.

Wanted Dead!

Buffelgrass is a perennial grass that is native to the uplands of central Asia and Africa. It is very resilient and can thrive over a wide precipitation range. It has little trouble gaining a foothold in shallow and poorly developed soils and is resistant to high temperatures. For these reasons it was brought to the Sonoran desert and planted by ranchers to turn barren desert into grasslands that could be used for more productive cattle grazing. This plan worked perfectly – too perfectly, in fact. Buffelgrass is able to grow in the desert better than the native grasses.



Invasion of buffelgrass in Saguaro over 13 years. The light tan on the hillside in 2000 is buffelgrass covering what was mostly rock in 1987.

Wanted Dead!

Buffelgrass and other invasive species are often spread through construction of roads. The disturbed area around the road is a prime spot for buffelgrass tracked in from other areas to gain a foothold and spread. It spreads at astonishing rates, taking space, sunlight and water from natural plants. And most importantly for saguaros it alters the natural fire regime. Wildfire is uncommon in the desert because the sparse natural grasses and shrubs simply do not provide enough fuel for wildfires to spread far or burn long. However, when the sparse natural vegetation is replaced with thick buffelgrass, wildfires can start more easily and burn hotter, longer and farther. While saguaros are well-adapted to the more mild wildfires sustained by native grasses and shrubs, they are often killed by fires that erupt and spread through areas invaded by buffelgrass.



The aftermath of a buffelgrass-fueled wildfire. Many century-old saguaros can die in a fire like this, and may never return as buffelgrass is already seen reestablishing shortly after the fire. Photo from the Pima County Exotic Species Council.

An Extreme Case: When Landscape Stress is Internalized

Most people tend to think of human development pressures occurring outside as opposed to inside parks, and fortunately in most situations this is the case. However, Saguaro is affected by a high-traffic commuter road (Picture Rocks road) that cuts directly across the western Tucson Mountain District. This major road is significant in a landscape context because it provides a direct illustration of how human developments and related pressures can impact park resources within park boundaries.

Many thousands of animals die on the road every year, including coyotes, tortoises, reptiles, and deer. Prime tracts of Wilderness are split by the road, making it more difficult for animals to move and interact. In addition to animals lost to roadkill, road noise can also scare them away, thus shrinking the effective sizes of remaining roadless areas within the Park.

Hence, Picture Rocks Road provides a direct view into the negative impacts that human developments like roads can have on park resources. We know about these impacts because the road is inside the Park and is thus especially well studied. Unfortunately, the effects of roads and other human developments outside parks are not usually as well documented, but their effects are nonetheless real for park resources that are maintained by landscapes that extend beyond park boundaries.



Surveys used to collect and document roadkill. NPS photo archive.

Concluding On a Lighter Note ...

Other protected areas, especially around the eastern Rincon Mountain District, help deter or prevent human development pressures and influences that would otherwise be considerably more extensive around Saguaro. The protected areas network within which Saguaro exists provides the anchor for natural resource conservation in the face of continued human development. But despite the challenges humans can pose to natural resource conservation it is also equally important to note the critical role they play as conservation stewards, both now and in the future as populations continue to rise and demographics change. This opportunity is especially apparent for Saguaro, which according to housing projections is on track to become a suburban park in the next few decades. Saguaro thus has the opportunity and responsibility to educate its local communities about the Park and park resources, and also engage them in conservation for the 21st century.

Solitude, scenic vistas, natural quiet and wild experiences are what drove our forefathers to create the US protected lands system. Without the support of the public our protected areas would be meaningless, non-functional, and ultimately a waste of time and money. Thankfully the American public has strongly supported national parks and continues to do so. Americans love to hit the trail and escape from the hustle and bustle of everyday life, but if tract housing, honking horns, and barking dogs are constantly apparent from the trail, does anyone want to escape here?

The landscape-level challenges facing Saguaro are not small, and they will not be easily solved. But through careful study, planning, management, and interpretation, Saguaro National Park can proactively take steps that will leave our most prized protected areas both functioning and pristine. Hopefully by the end of this century, the graceful saguaros will still be standing, and the unique and irreplaceable natural resources that are afforded protection by Saguaro National Park will still be available to Americans.

More Information

Saguaro National Park
<http://www.nps.gov/sagu/index.htm>

Sonoran Desert Inventory and Monitoring Network
<http://science.nature.nps.gov/im/units/sodn/index.cfm>

NPScape - Landscape Dynamics Monitoring
<http://science.nature.nps.gov/im/monitor/npscape/>